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DESIGN OF A ROUGH TERRAIN E-BIKE WITH THREE WHEEL

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ABSTRACT:

The purpose of this article is to design and build a three-wheeled electric bike with double suspension that can be used for both fast riding and tough terrain. An electric bicycle is a device that combines the functionality of a bike with the addition of an electric motor to provide propulsion. A motorised bicycle with an integrated electric motor for propulsion is called an electric bicycle, or e-bike. While there are many different types of e-bikes on the market, they may be broadly classified into two categories: bikes that provide a throttle and bikes that supplement the rider's pedal force. Rechargeable batteries are used in the production of e-bikes, which are usually motor-powered and capable of speeds exceeding 60 kmph. The fundamental idea behind a three-wheel e-bike is that electrical energy from a D.C. battery is transferred to an electromotive force in a motor. Our e-bike has an inventive three-wheel design in which the handle and body rest on a special suspension joint linkage configuration, while the front two wheels are linked in a separate frame. Our e-bike has a maximum speed of 80 kmph and a maximum range of 70 km.

Keywords: rechargeable batteries, D.C. motor, three-wheeled electric bike

INTRODUCTION

Energy crisis is one of the major concerns in today's world due to fast depleting resources of petrol, diesel and natural gas. In combination with this, environmental decay is an additional factor which is contributing to the depletion of resources which is an alarming notification. An Electric Bike or Scooter is a battery operated vehicle that is very economical with low maintenance cost and zero pollution. Electric two wheelers use the electrical technology of rechargeable battery that converts the electrical energy into mechanical energy. The battery of an EV can be charged easily using a power connection. There are many possible types of electric motorized bicycles with several technologies available, varying in cost and complexity; direct-drive and geared motor units are both used.

1.1. Project Overview

The progress of automobiles for transportation has been intimately associated with the progress of civilization. The automobile of today is the result of the accumulation of many years of pioneering research and development. In the modern trend automobiles have certain disadvantages such as fuel cost relative to mileage, pollution, less efficiency, poor balancing and inability to move over rough terrain. We are introducing an advanced rough terrain 3-wheel E-bike project incorporating an innovation within in the vehicle.

Basic Working

A 3-wheel e-bike typically consists of a battery, an

electric motor, a controller, and three wheels. The battery powers the electric motor, which propels the bike forward. The controller is responsible for regulating the speed and power of the motor. To operate a 3-wheel e-bike, the rider needs to switch on the key to start the motor. Once the motor is on, the rider can adjust the speed and power using the controller.

Problem Statement

The main goal is to design a 3 wheel e- bike which can use renewable energy as a power source and provide additional stability to the rider over rough terrain. The devastating problem on both biotic and abiotic components of our home (i.e. pollution) can be reduced by using e-bike as the major mode of transportation in the urban area as well as tough terrains. A natural gift like fossil fuels, wood, etc. which are limited in amount can be saved from crisis and extinction. For people, due to its more efficiency and less harmful impacts, rough terrain 3-wheel e-bike might be good decision for the intermediate future. So, this project can practically demonstrate effect of this variation to people.

LITERATURE SURVEY

H. T. Kim have discussed about the ergonomic design of a 3-wheel e-bike for the elderly population.

J. S. Kim have discussed about the presents the design and development of a 3-wheel e-bike for urban use. The study found that the e-bike was suitable for short-distance travel in urban areas and had a low carbon footprint.

S. Y. Kim have discussed about the performance analysis of a 3-wheel e-bike for urban transportation. The study found that the e-bike was a viable mode of transportation for short-distance travel in urban areas.

R. G. McKee have discussed about the design and performance factors of electric 3-wheel bikes, including battery life, motor power, and stability.

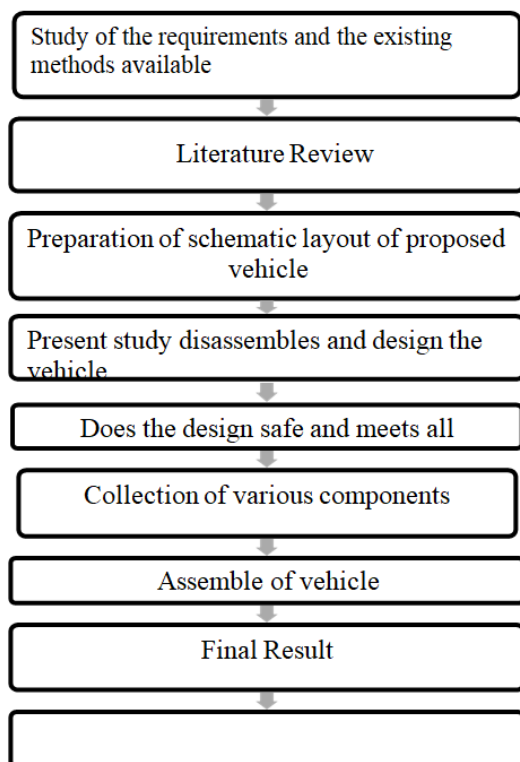
P. Ferrara have discussed about the study to evaluates the use of 3-wheel e-bikes as a sustainable mobility solution in urban areas.

METHODOLOGY

The methodology is a process for implementation and developing the project. With the goal of successfulness of the project is depending on how the plans is conduct to achieve the result. Methodology is to define each step to achieve the sequence of the flow work from the beginning until the outcome is obtained.

3.1 Introduction with Work Flow Chart

The methodology could be a method for implementation and developing the project. With the goal of prosperity of the project is looking on however the plans is conducted to realize the result.



3.2 Project Planning

The below figure is a schematic representation of basic design of the system. The below diagram shows the flow of control in the systems and the

display of various components present in the system. The system consists of a chain drive motor that is driven by the 48V li-ion battery pack. The other components which are present are frame, throttle, sprocket, rear wheel, front 2 wheel.

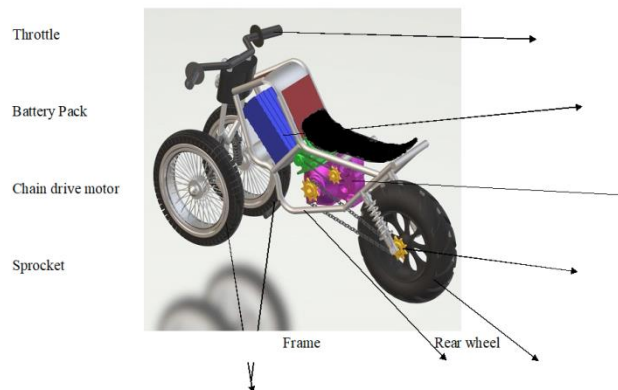


Figure-1 Design of bike Front 2 wheels
Figure-1 Side view of proposed 3 wheel E-Bike

The above figure shows the final layout and basic positioning of the parts in the system. In the system the chain drive motor is placed in the center of the vehicle to provide better stability for the rider.

Vehicle: The E bike employs the frame, chassis and other structural components are adopted from a normal Bike.



Figure 2 - SolidWorks 2012 displaying a 3D assembly in multiple views.

Developer(s)	Dassault Systems
Initial release	November 1, 1995; 26 years ago
Stable release	SolidWorks 2021 SP2.0 / January 11, 2021
Operating system	Microsoft Windows
Type	CAD and CAE

Table 1 – Solid works Information

Battery: The battery is required to supply energy to

run the vehicle through the chain drive Motor. The battery is 48V/30Ahr

Building a model in SolidWorks usually starts with a 2D sketch (although 3D sketches are available for power users). The sketch consists of geometry such as points, lines, arcs, conics (except the hyperbola), and splines. Dimensions are added to the sketch to define the size and location of the geometry.

DESIGN OF VARIOUS PARTS: There are tons of bike-specific terminology to understand if you want to get to grips with how your machine works and what each bike component does. Some are pretty obvious and self-explanatory, whereas other bike parts are a bit trickier.

Bike components such as bottom brackets and freehubs have a lot of complexity hidden away – and bike brands seem to love to come up with new and slightly different ways of doing things. Even pedals come in a confusing number of variants.

Design of Fram



Figure-3 Bike Frame Design

Tools used –

Draw the sketches for the frame and trim the extra parts from them. Creating an angle and turning the sketch by 90 degrees.

Make the Solid Sweep from the required draw the union.

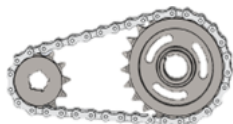


Fig-4 Chain Sprocket and path Design

Tool Used –

Select the front plane and sketch the chain sprocket. With the help of extruded boss tool, extrude the chain sprocket. Now use the extruded cut tool to obtain the required shape.

Isometric View –

Isometric view uses segments of equal length to create three dimensional images on a two-dimensional surface. Since isometric means equal measure, from the Greek derivation, images in isometric view should be drawn so that they have equal size pieces. As seen in the image of the cube, the result is that the axes intersect at 120-degree angles.

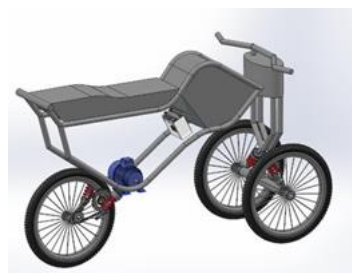


Figure-5 Vehicle Isometric View

Side View:

The side view is a drawing that shows the object as it would appear from the side. It is a two-dimensional representation of the object, with the height and width dimensions shown in their true proportions, but the depth dimension shown as a single line.



Figure-6 Vehicle Side View

REQUIRED COMPONENTS FOR THREE WHEEL E-BIKE High Power Motor

An electric motor that is intended to produce a large quantity of power or mechanical output is known as a high-power motor. It can provide a lot of torque and handle heavy loads. Applications requiring a lot of power, like industrial machines, electric cars, marine propulsion, aerospace systems, and heavy equipment, use high-power motors.

Specifications of Power Motor

Power	750W
Voltage	48V DC
Speed	480r/min
Type	Chain Driven

Table-2 Specifications of power motor

Chain Drive

In battery-powered vehicles like electric motorcycles and bicycles, chain drives are a typical form of propulsion. Chain drives provide effective power transfer and consist of a motor-driven sprocket, a chain, and one or more sprockets on the wheels or drivetrain. Chain drives enable efficient power transfer, resulting in increased overall performance, with mechanical efficiencies

that are typically in the range of 90% to 95%. Chain drives have the ability to change gear ratios, which is one advantage. In order to achieve optimal performance and endurance, chain drives do need routine maintenance. To minimize wear, reduce friction, and prevent chain failure, routine chores including cleaning, lubrication, and tension adjustment are required.

Motor Mount

A motor mount is a key component that houses and secures an electric motor in place in various industry and automotive systems. Its main job is to stabilize and support the motor, guaranteeing perfect alignment and reducing noise and vibration. Usually, motor mounts are made to withstand the mechanical forces and stresses that are produced when a motor is operating. Durable materials that offer strength and stiffness, such steel or aluminum, are used to build motor mounts. They are designed to support the weight and torque generated by the motor, offering a stable attachment to the machinery or vehicle's chassis.



Figure-7 Motor Mount

Shock Absorbers

To manage and reduce the impacts of shocks and vibrations, vehicles and machines must include shock absorbers, sometimes referred to as dampers. Their main job is to dissipate the energy produced by bumps, uneven terrain, and other disturbances, resulting in a smoother and more controllable functioning. The oscillations and vibrations brought on by these disturbances are dampened by shock absorbers in conjunction with springs.

Drum Brakes

Although the widespread use of disc brakes in recent years has reduced the use of drum brakes, they are still a common braking method for motorbikes. However, some motorcycles still have drum brakes, especially entry-level or inexpensive versions. A drum brake consists of a metal drum that is mounted to the wheel and is often constructed of cast iron or aluminium. Curved brake shoes that are lined with friction material and located inside the drum are frequently referred to as brake linings or brake pads.



Figure-8 Drum Brake Handle Drum Brake E-Bike

The motorcycle's handlebar, sometimes known as the "motorbike handle," is an essential part that gives the rider control and manoeuvrability of the vehicle. It is often built of a robust, long-lasting material like metal, such steel or aluminium, and is intended to be lightweight. A major bar that extends horizontally from the steering stem of the motorcycle's front forks makes up the handlebar.

Battery : E-bikes frequently employ lithium-ion (Li-ion) batteries because of their high energy density, lightweight construction, and long cycle life. They provide an extended range and constant performance for electric bikes, making them a dependable and efficient power supply. The following details on lithium-ion batteries used in e-bikes:

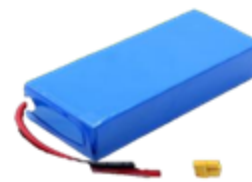


Figure-9 Li-ion Battery

Specifications of battery

Weight	3.4 Kg
Voltage	48V
Current	30A
Charging Speed	6-7 hrs.
Discharge Speed	4-5 hrs.

Table-3 Specifications of Li-ion battery

Specifications of controller

Confined Voltage	40-50V
Confined current	45A
Power	1000-1500W
Temperature	60-120 C

Table-4 Specifications of controller

RESULT

Stability: The three-wheel design provides enhanced stability, especially on uneven or challenging terrains. The additional wheel adds stability and balance, making it easier to navigate rough terrain with confidence.

Off-road Capability: A rough terrain 3-wheel e-bike is designed to handle various off-road conditions, including gravel, dirt trails, and rocky surfaces.

Electric Assistance: The e-bike features electric assistance, which means it is equipped with a motor and battery to provide pedal-assist or full electric propulsion. This makes it easier to traverse rough terrain, particularly when climbing hills or tackling steep inclines.

Enhanced Comfort: Rough terrain 3-wheel e-bikes often feature suspension systems to absorb shocks and vibrations from uneven surfaces. This results in a smoother and more comfortable ride, reducing the impact on the rider's body and enhancing overall comfort during off-road adventures.

Accessibility: The three-wheel design of these e-bikes can make them more accessible for riders with balance or mobility issues. The additional stability provided by the third wheel can instill confidence and allow individuals who may struggle with traditional bicycles to enjoy off-road adventures.

CONCLUSION

Rough terrain 3-wheel e-bikes are specially designed vehicles that perform well in off-road conditions. They provide a host of benefits for riders who are daring. These e-bikes are perfect for climbing uneven areas, gravel walks, and dirt trails

because of their special three-wheel design, which improves stability, control, and traction. Better balance and a lower chance of toppling over are produced by the extra wheel at the front, which uniformly distributes the weight, particularly on difficult terrain. Riding on more stable terrain gives riders more confidence, enabling them to push their boundaries and tackle difficult tracks with ease.

REFERENCES

The sites which were used while doing this project:

www.wikipedia.com

www.researchgate.net

www.iopscience.iop.org

www.ijiet.org

"Ergonomic Design of a 3-Wheel Electric Bike for the Elderly Population" by H. T. Kim [online]. Available:

https://www.researchgate.net/publication/362610768_Ergonomic_Design_Of_E_Bike_For_Elderly_Population

"Design and Development of a 3-Wheel Electric Bicycle for Urban Use" by J. S. Kim [online]. Available:

https://www.researchgate.net/publication/350979118_Design_Development_of_electric_bicycle_for_Urban_Use

"Performance Analysis of a 3-Wheel Electric Bike for Urban Transportation" by S. Y. Kim [Online]. Available:

https://www.google.com/search?rlz=1C1UEAD_enIN1005IN1005&sxsrf=APwXEdfyK1a62nAE0P3pZxRjhjt482jCuA:1684943865008&q=Performance+Analysis+of+a+3Wheel+Electric+Bike+for+Urban+Transportation+by+S.+Y.+Kim&sa

"Electric 3-Wheel Bikes: A Compendium of Design and Performance Factors" by R. G. McKee [online]. Available:

https://www.researchgate.net/publication/316995569_Electric_3_Wheel_Bike_A_Compendum_of_Design

"The electric three-wheeler: A sustainable mobility solution for urban areas" by P. Ferrara [Online]. Available:

<https://www.dspace.com/en/pub/home/applicationfields/indappl/automotive>

[industry/emobility.cfm?gclid=CjwKCAjw67ajBhAVEiwA2g_jED_D7kNEpeehuy5](https://www.dspace.com/en/pub/home/applicationfields/indappl/automotive/industry/emobility.cfm?gclid=CjwKCAjw67ajBhAVEiwA2g_jED_D7kNEpeehuy5)

"Development of a Three-Wheeled Electric Bicycle for the Elderly" by K. H. Kim [Online]. Available:

<https://www.irejournals.com/formatedpaper/1700100.pdf>

. "Design and Optimization of a Three-Wheeled Electric Bicycle" by Jianhua Zhang [Online]. Available:

https://www.researchgate.net/publication/343611744_Lightweight_design_and_optimization_of_the_speed_electric_bike

. "Electric three-wheelers in India: Opportunities and challenges" by Ashish Verma [Online]. Available:

https://cp.catapult.org.uk/wpcontent/uploads/2021/03/210318_1020_CPC_India_Report.pdf

"Electric three-wheelers in China: An analysis of user characteristics, driving patterns, and charging behaviour" by Shaheen [Online]. Available:

https://www.researchgate.net/publication/355722079_Patterns_of_Electric_Vehicles_in_China

"Electric 3-Wheeled Vehicles: A Review" by R. H. A. van der Heijden and L. C. J. van der Werff [Online]. Available: